

PICTURE THIS: HOT MEASUREMENT AND MODELING METHODS IN MOVEMENT DISORDERS RESEARCH

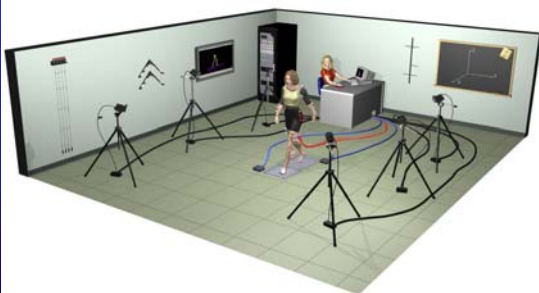
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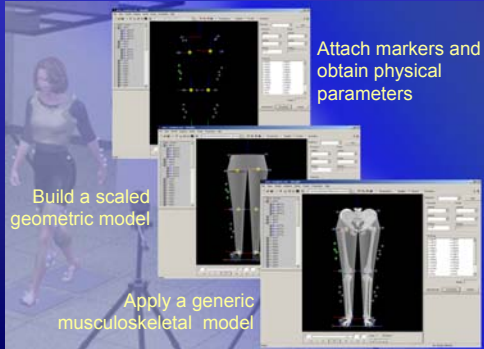
Warren Grant Magnuson Clinical Center & the Clinical Research Center



Movement Analysis Laboratory



Overview of the basic process

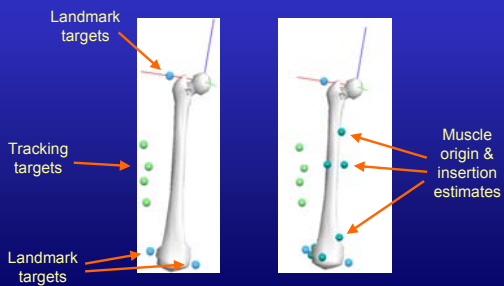


Enhanced Movement Analysis (6 DOF Joint Models)

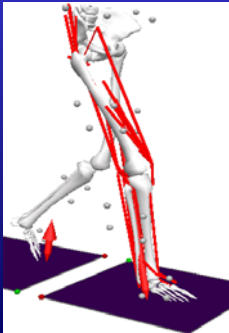


Visual inspection of data/errors

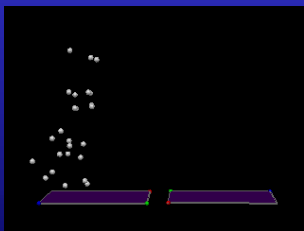
Enhanced Movement Analysis (Muscle kinematics)



Enhanced Movement Analysis (Muscle lines of action)

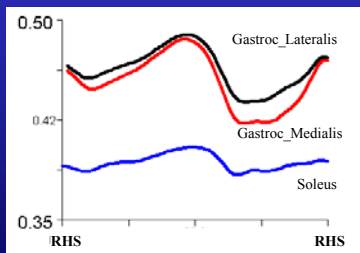


Picture this: (Modeling Methods)



Repeat animation of walking
depicting various models

Muscle Kinematics



Muscle Kinematics

Muscle lines of action

Muscle length changes

Muscle contraction velocities

Are precursors to:

Individual muscle motion control "sensitivities"

Individual muscle forces and their effects?

Picture this: (Motion control sensitivities)

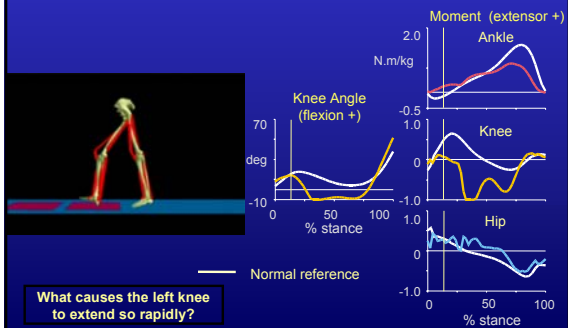


Patient case



- 54 y/o Male
- Amyotrophic lateral sclerosis
- Impairments: lower extremity weakness
Left (2/5), right (4/5)

Patient case - Motion and Moments



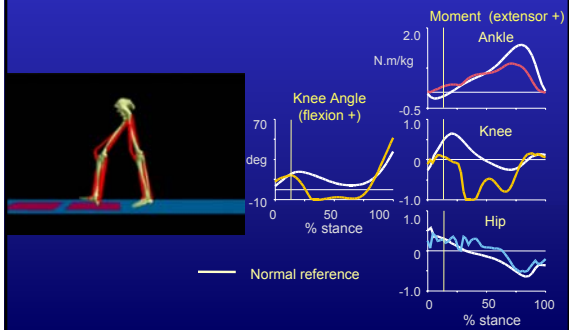
Picture this: The ability to inspect all possible causes



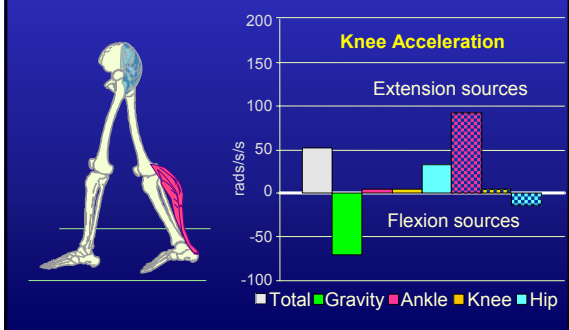
Induced Acceleration Analysis (IAA)

1. Perform a movement analysis that includes inverse dynamics analysis.
2. Insert one sample (instant) of the subject's measured position and force data into a **coupled dynamics** model.
3. Numerically explore the set of **coupled dynamics** equations to determine the muscle moment/joint movement (acceleration) relationships.
4. Return to step 2 until last instant.

Patient case - Motion and Moments



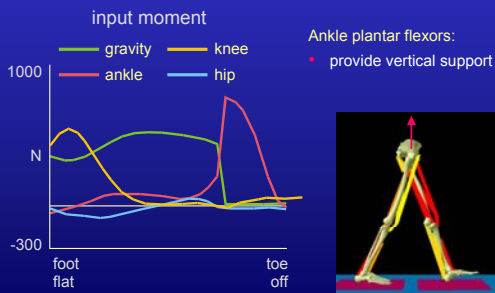
IAA – Left Knee Control



Motion simulation using right ankle moment



COM Control – Vertical Force / Acceleration



Picture this: Contribution of assistive technologies

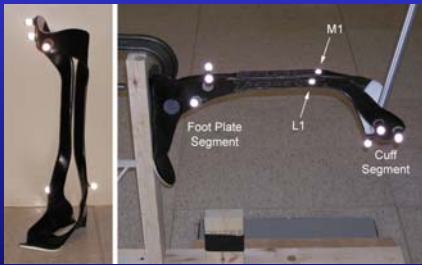


Advanced Prosthetics and Orthotics Inc., Encinitas, CA

Determining the AFO's contribution

Understanding the contribution of a Dynamic Ankle Foot Orthosis (DAFO) and the patient's adaptation to the DAFO during the stance phase of gait are important steps towards predicting and obtaining desired outcomes.

Dynamic AFO Model



STIFFNESS MODELS

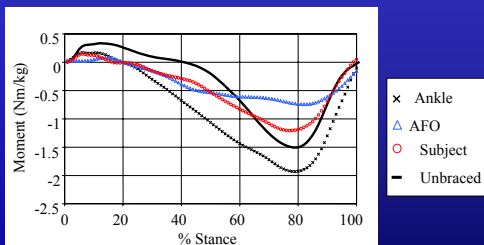
| | Subject 1 | Subject 2 |
|--------------|-----------|-----------|
| KDF (Nm/deg) | -4.0 | -3.0 |
| KPF (Nm/deg) | -6.5 | -4.5 |

Dynamic AFO - Subjects

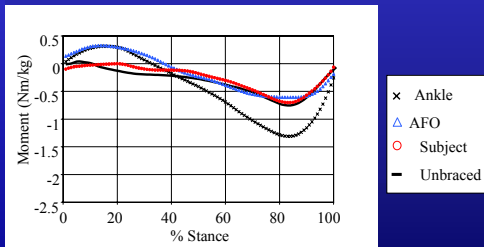
| | Subject 1 | Subject 2 |
|--------------|-----------------------|---|
| Diagnosis | Post Polio Syndrome | Post Polio Syndrome |
| Age/Gender | 66/M | 58/F |
| Ht/Wt (m/kg) | 1.85/81.8 | 1.6/52.3 |
| Prescription | Bilateral Dynamic AFO | Dynamic AFO - Left 5/8" Lift - Right |

| | Subject 1 | Subject 2 |
|-------------------------------|-----------|-----------|
| Speed Unbraced (Stat/s) | 0.65 | 0.55 |
| Speed AFO (Stat/s) | Same | Faster |
| Stride Length Unbraced (Stat) | 0.84 | 0.68 |
| Stride Length AFO (Stat) | Same | Longer |

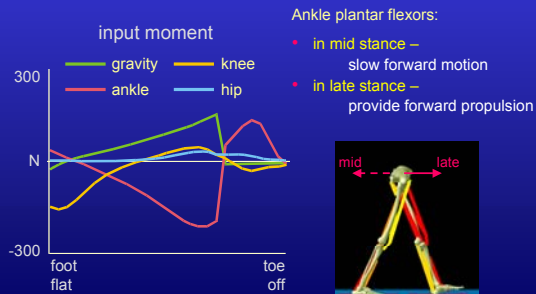
Subject 1



Subject 2



COM Control – A/P Force / Acceleration



Summary

6 Degree of Freedom Models
(visualization)
Muscle Kinematics (LOA)
Induced Acceleration Analysis (IAA)
Limb (joint) control
Body support & propulsion
Contribution of assistive technology

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